

ASTEROID ITOKAWA (LL CHONDRITE) REGOLITH SIZE FREQUENCY CHARACTERISTICS AND COMPARISON TO DISAGGREGATED TAGISH LAKE (C2 UNGROUPED) METEORITE FRAGMENTS

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Introduction: Asteroid compositional diversity is indicated by spectral and albedo variation and the lithologic range of recovered meteorites. Asteroid regoliths have proven to be unexpectedly ubiquitous and have been imaged with varying resolution on asteroids Gaspra, Ida, Mathilde, Eros, Itokawa, Stein, and Lutetia, and the analogous Martian Moons, Deimos and Phobos. The characteristics of asteroid regolith, and the processes that produce it, are of increasing interest as asteroid sampling missions have begun and asteroid dynamic responses to orbit diversion techniques are considered. In this study, we begin by comparing Itokawa [1] regolith fragments' size-frequency and shape distributions between three different terranes. We then determine the size-frequency and shape distributions of fragments of disaggregating Tagish Lake meteorite [2] to compare fragmentation in the much weaker dark asteroid lithologies.

Data Analysis and Results: Image "st_2532629277_v.fits" from the Descent and touchdown sequence of Hayabusa [3] was used to calculate the size frequency distribution of fragments on four equal areas. The image resolution of 10 cm/pixel allowed four areas of ~170 m² to be picked on the typical rough terrane and two smooth areas (within Komaba crater and Muses-C). The cumulative size frequency distributions of fragments on the rough terrains yielded a slope of -1.63 and -1.32 while Komaba crater and Muses-C had a slope of -3.33 and -3.07; respectively. The mean b/a axial ratios of the fragments were found to be 0.73±0.03 and 0.75±0.03 within Komaba crater and the Muses-C region; respectively.

A total of 195 fragments of Tagish Lake meteorite were measured with a digital caliber and produced a cumulative size distribution slope of -5.7 and their calculated axial ratios b/a and c/a had mean values of 0.76±0.01 and 0.53±0.01; respectively. Note that working with fragments allows measuring of three axes; imagery data allows measurement of only two and an assumption of flat-lying fragments is required to conclude that the measured ratio corresponds to b/a.

Discussion: The size frequency within Komaba, a 30 m-diameter crater, had a steeper slope than those of the rough terrane (and even steeper than that of the Muses-C region where abundant fine material collected), indicating that impact-induced fracturing and intra-cratering flows are very effective in eliminating larger fragments and resulting in a more uniform size distribution consistent with observed terrestrial erosion processes.

Tagish Lake meteorite fragment samples show a significantly steeper slope for the cumulative size distribution compared to Itokawa terranes. The steeper slope of the Tagish Lake lithologies is interpreted to reflect the lower strength of these hydrated phyllosilicate lithologies (typical of other similar meteorite lithologies such as CI and CM). This implies that the easier fracturing of Tagish Lake-like lithologies will result in enhanced regolith generation on their parent bodies. However, the b/a fragment axial ratio remain the same for the lithologies of contrasting strengths.

References: [1] Fujiwara et al. 2006.*Science*. 312:1330–1334. [2] Hildebrand A. R. et al 2006. *Meteoritics & Planetary Science* 41:407-431. [3] <http://darts.isas.jaxa.jp/planet/project/hayabusa/amica>